

## COMMENTS AND RESPONSES

### High Baseline Vitamin C Levels Do Not Prevent a Positive Outcome of a Lifestyle Intervention

Response to Thamer et al.

In a recent issue of *Diabetes Care*, Thamer et al. (1) addressed the question of whether baseline plasma vitamin C levels influence the outcome of a dietary and exercise intervention in 86 individuals at increased risk for developing type 2 diabetes.

Oxidative stress caused by increased formation of reactive oxygen species during physical exercise has previously been proposed to be an important mediator of insulin sensitivity. In a prospective intervention study (2), we have recently shown that regular intake of combined vitamin C and E supplements prevents the insulin-sensitizing effects of daily physical exercise. In apparent contrast, Thamer et al. find positive associations of plasma vitamin C concentrations with serum markers of insulin sensitivity. Notably, these associations lost significance after multivariate correction for adiposity (1). Moreover, BMI and plasma vitamin C levels were inversely associated in this study (1). These findings per se suggest that plasma vitamin C levels may be simply indicative of healthy dietary habits. More importantly, Thamer et al. have evaluated study nonsupplemented subjects

with an increased risk for type 2 diabetes (1), whereas our study has determined the effects of vitamin supplementation in young healthy adults (2).

Plasma vitamin C concentrations are widely used as surrogate markers of dietary intake of fruits and vegetables (3). A number of prospective studies have demonstrated the potential of increased dietary intake of fruits and vegetables to act as a type 2 diabetes-preventive factor as cited and discussed by Thamer et al. (1), our study (2), and others (4). In contrast, prospective studies examining defined vitamin supplements after correction for dietary habits have found no beneficial influence of vitamin C supplements on glucose metabolism (4), and our study demonstrated a clear effect of combined vitamins C and E supplementation of the insulin-sensitizing effect of exercise training (2). As discussed extensively in the respective publications, these latter (4) and our own (2) findings suggest that while fruits and vegetables may have an effect in preventing or delaying type 2 diabetes, supplementation with antioxidants is not likely to do the same.

As proposed in an earlier study (5) and now supported by the study by Thamer et al. (1), fruits and vegetables may exert their diabetes-preventive potential independent of their content in vitamin C. Thus, as we previously emphasized (2), antioxidant supplements cannot compensate for inadequate intake of dietary fruits and vegetables in regards to the prevention of type 2 diabetes.

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